METHOD AND APPARATUS FOR DETERMINING SEARCH CENTER AND SIZE IN SEARCHES FOR GPS TRANSMISSIONS

RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. patent application Ser. No. 09/040,501, entitled "System and Method for Determining the Position of a Wireless CDMA Transceiver", filed on Mar. 17, 1998, now U.S. Pat. No. 6,081,229.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to communications systems. More specifically, the present invention relates to systems and techniques for locating the position of a wireless communication device in a code division multiple access system.

2. Description of the Related Art

Deployment of location technologies in wireless networks is being driven by regulatory forces and carriers' desires to enhance revenues by differentiating the services offered by one carrier from the services offered by others. In addition, in June 1996, the Federal Communications Commission (FCC) mandated support for enhanced emergency 911 (E-911) service. Phase I of the Order requires that sector and cell information be set back to the PSAP (Public Safety Answering Point) agency. Phase II of the Order requires that the location of the cellular transceiver be sent back to the PSAP. To comply with the FCC mandate, 77,000 total sites are to be equipped with automatic location technologies by the year 2005.

Many techniques are being considered to provide automatic location capability. One technique being considered involves measuring the time difference of arrival of signals from a number of cell sites. These signals are triangulated to extract location information. Unfortunately, this technique requires a high concentration of cell sites and/or an increase in the transmission power of the sites to be effective. This is due to the fact that in a typical CDMA system, each telephone transmits with only enough signal power to reach the closest cell site. As triangulation requires communication with at least three sites, the concentration of cell sites would have to be increased or the signal power of each wireless communication device would have to be increased.

In any event, each alternative has significant drawbacks. An increase in the number of cell sites would be too costly. Increases in signal power would add to the weight and cost of each wireless communication device and increase the likelihood of interference between wireless users. In addition, the network triangulation approach does not appear to meet the FCC mandate requirements.

Another approach being considered involves the addition of GPS (Global Positioning System) functionality to the cellular telephone. Although this approach would add significant cost and weight to the wireless communication device, require a line-of-sight to four satellites, and would be somewhat slow, nevertheless, it is the most accurate approach to support location services.

To speed the process, a third approach sends aiding information to the wireless communication device indicating where the wireless communication device should look in frequency for GPS carriers. Most GPS receivers use what is known as a GPS satellite almanac to minimize a search performed by the receiver in the frequency domain for a signal from a visible satellite. The almanac is a 15,000 bit block of coarse ephemeris and time model data for the entire constellation. The information in the almanac regarding the position of the satellite and the current time of day is approximate only. Without an almanac, the GPS receiver must conduct the widest possible frequency search to acquire a satellite signal. Additional processing is required to attain additional information that will aid in acquiring other satellites.

The signal acquisition process can take several minutes due to the large number of frequency bins that need to be searched. Each frequency bin has a center frequency and predefined width. The availability of the almanac reduces the uncertainty in satellite Doppler and therefore the number of bins that must be searched.

The satellite almanac can be extracted from the GPS navigation message or sent on the down (forward) link as a data or signaling message to the receiver. Upon receipt of this information, the receiver performs GPS signal processing to determine its location. While this approach may be somewhat faster, it suffers from the requirement of a line-of-sight to at least four satellites. This may be problematic in urban environments.

Hence, a need remains in the art for a fast, accurate and inexpensive system or technique for locating a cellular.

SUMMARY OF THE INVENTION

The need in the art is addressed by the system and method presently disclosed for determining the position of a wireless transceiver. In the most general sense, the inventive method is a hybrid approach for determining position using ranging information from a terrestrial system, timing information from a wireless communication device, and ranging information from GPS satellites. This information is combined to allow the position of a wireless communication device to rapidly and reliably determined. The disclosed method includes the steps of receiving at a wireless communication device, a first signal transmitted from a first GPS satellite, a second signal transmitted from a second GPS satellite, and a third signal form a third satellite. The wireless communication device is adapted to receive these GPS signals and transmit a fourth signal to the base station in response thereto. The base station receives the fourth signal, corrects for the clock bias imposed on the fourth signal by the round trip delay between the base station and the wireless communication device and uses the unbiased fourth signal to calculate the position of the wireless communication device.

In a specific implementation, the base station sends aiding information to the wireless communication device. The aiding information is used by the wireless communication device to quickly acquire the signals transmitted by the first, second and third satellites. The aiding signals are derived from information collected at the base station transceiver subsystem (BTS) serving the wireless communication device, Base Station Controller (BSC), or some other entity and includes: (1) satellite identification information; (2) Doppler shift or related information; (3) values indicating the distance between the base station and each satellite; and (4) a search window size associated with each satellite, the search window size being calculated based on the round trip delay between the wireless communication device and the base station and the elevation angle of each satellite.

Upon acquisition by the wireless communication device of the signals transmitted by the first, second and third satellites, the wireless communication device calculates the range pm**1**, between the wireless communication device and